NETL 2002 Conference on SCR & SNCR for NO_x Control

SCR Inlet Maldistributions - Their Effects & Strategies for Their Control

by

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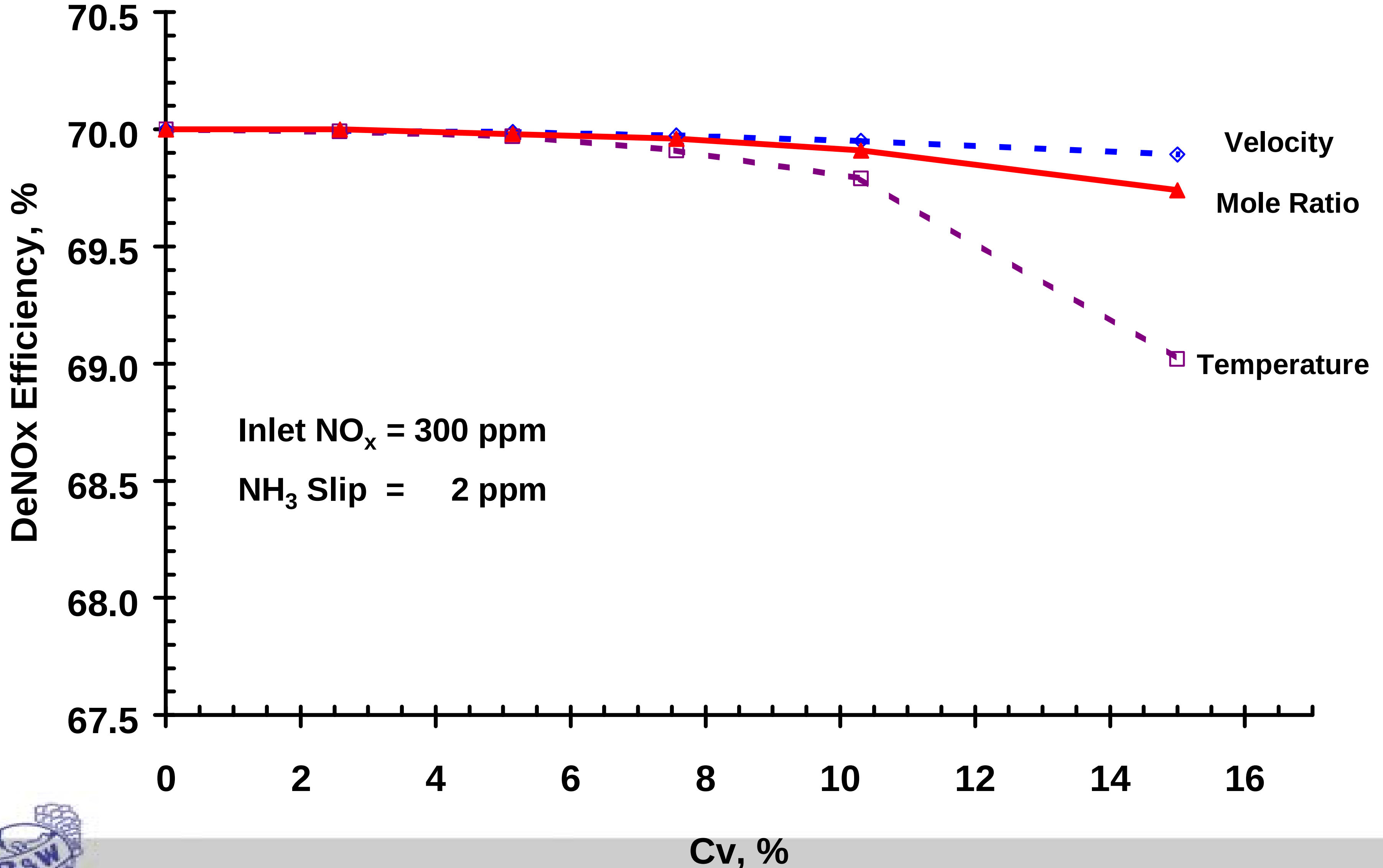
Expressing the Degree of Non-Uniformity with the Coefficient of Variation

$$Cv = \frac{\sigma}{\overline{x}} 100\,\%$$

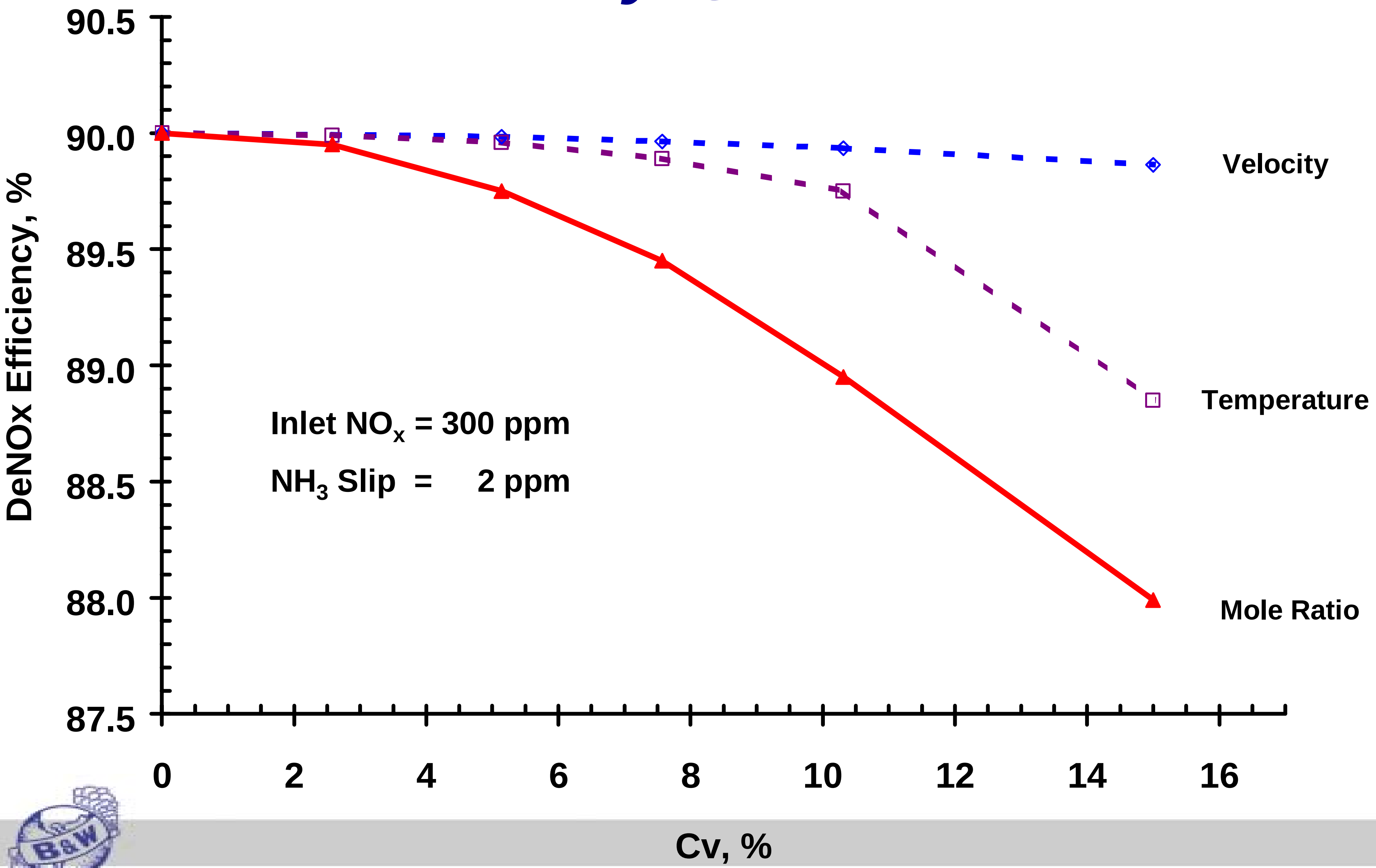
$$\sigma = \sqrt{\frac{1}{(n-1)} \sum_{i=1}^{n} (x_i - \overline{x})^2}$$

$$\overline{x} = \frac{1}{n} \sum_{i=1}^{n} x_i$$

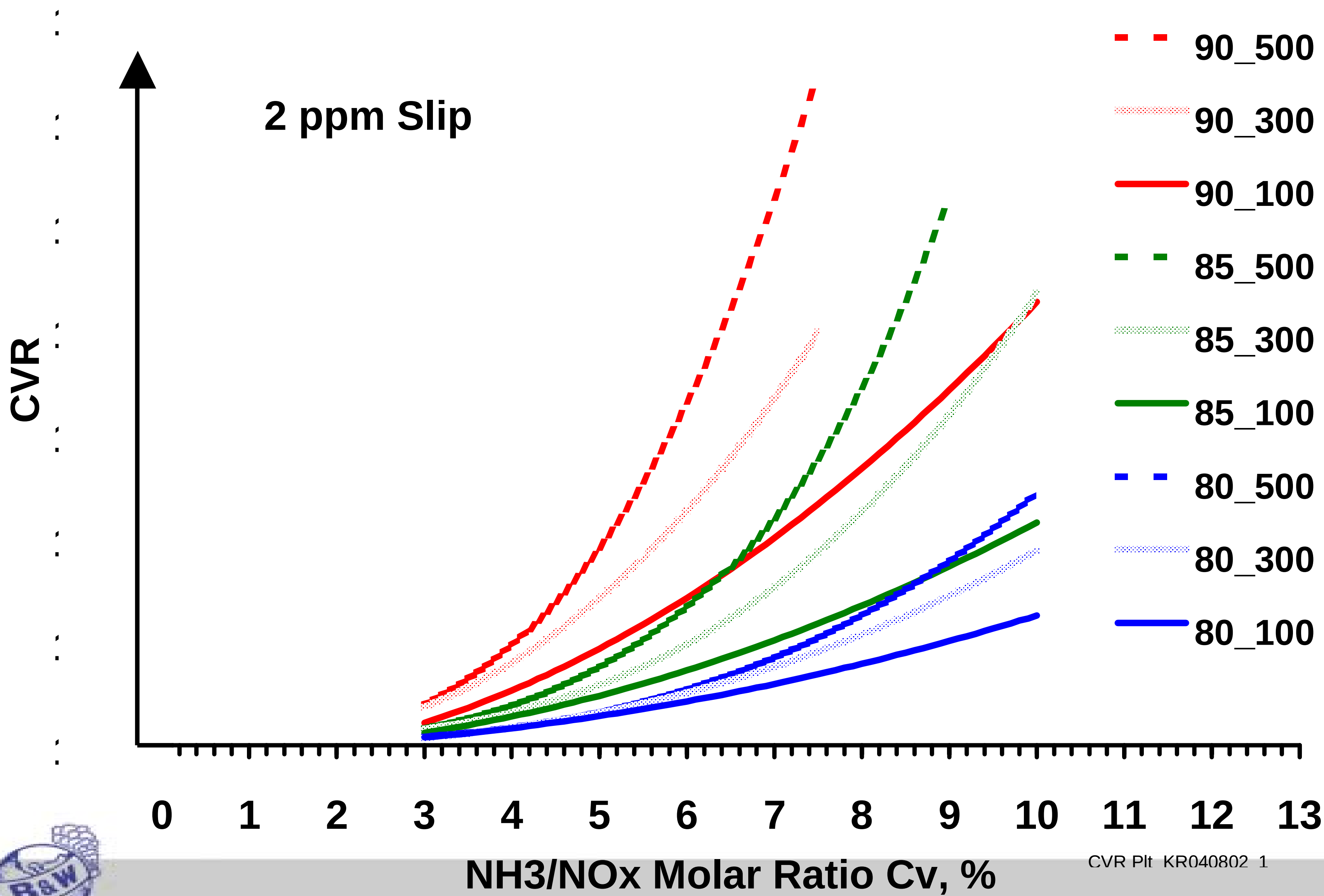
Influence of Maldistributions on SCR Reactor Efficiency @ 70% DeNOx



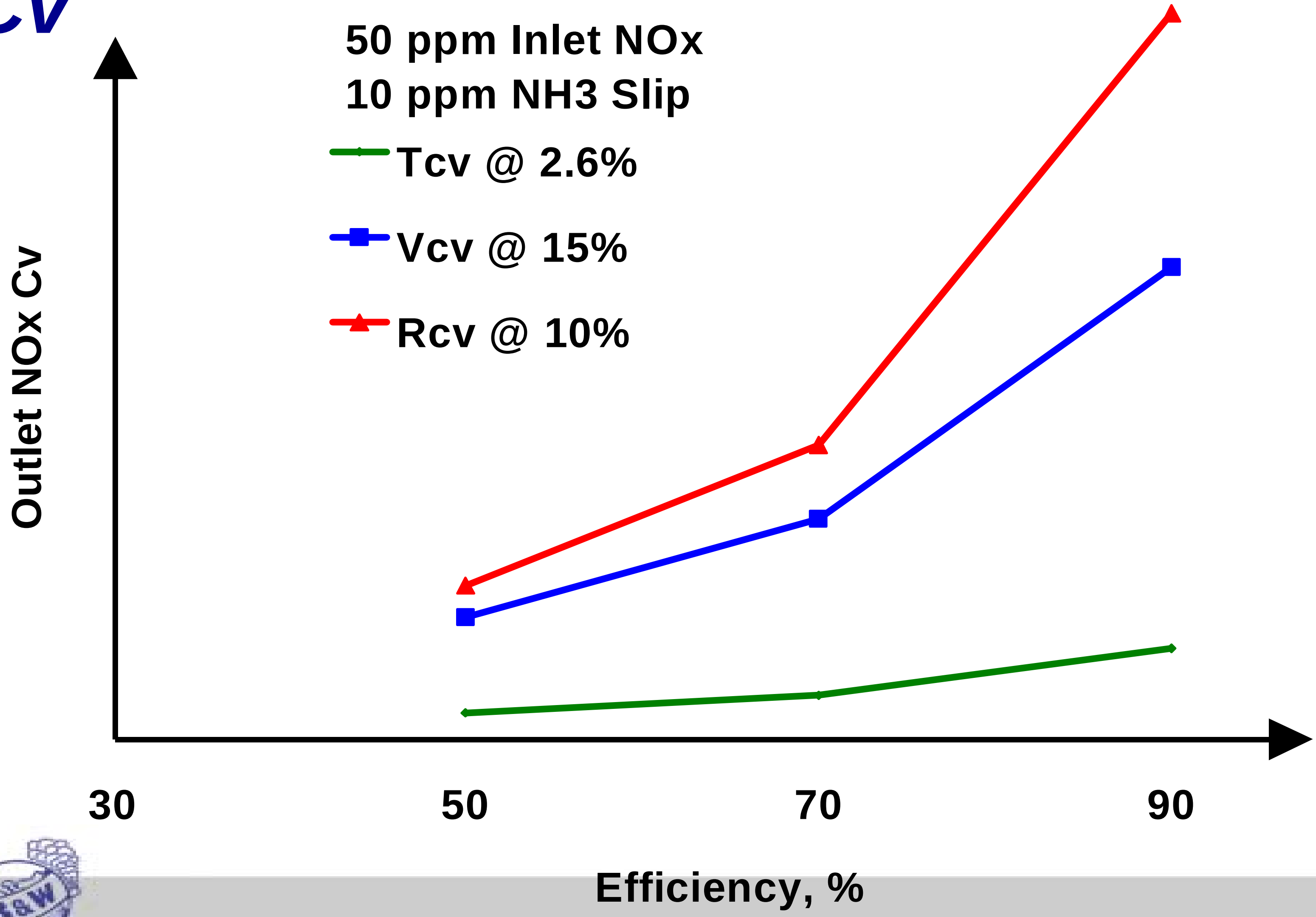
Influence of Maldistributions on SCR Reactor Efficiency @ 90% DeNOx



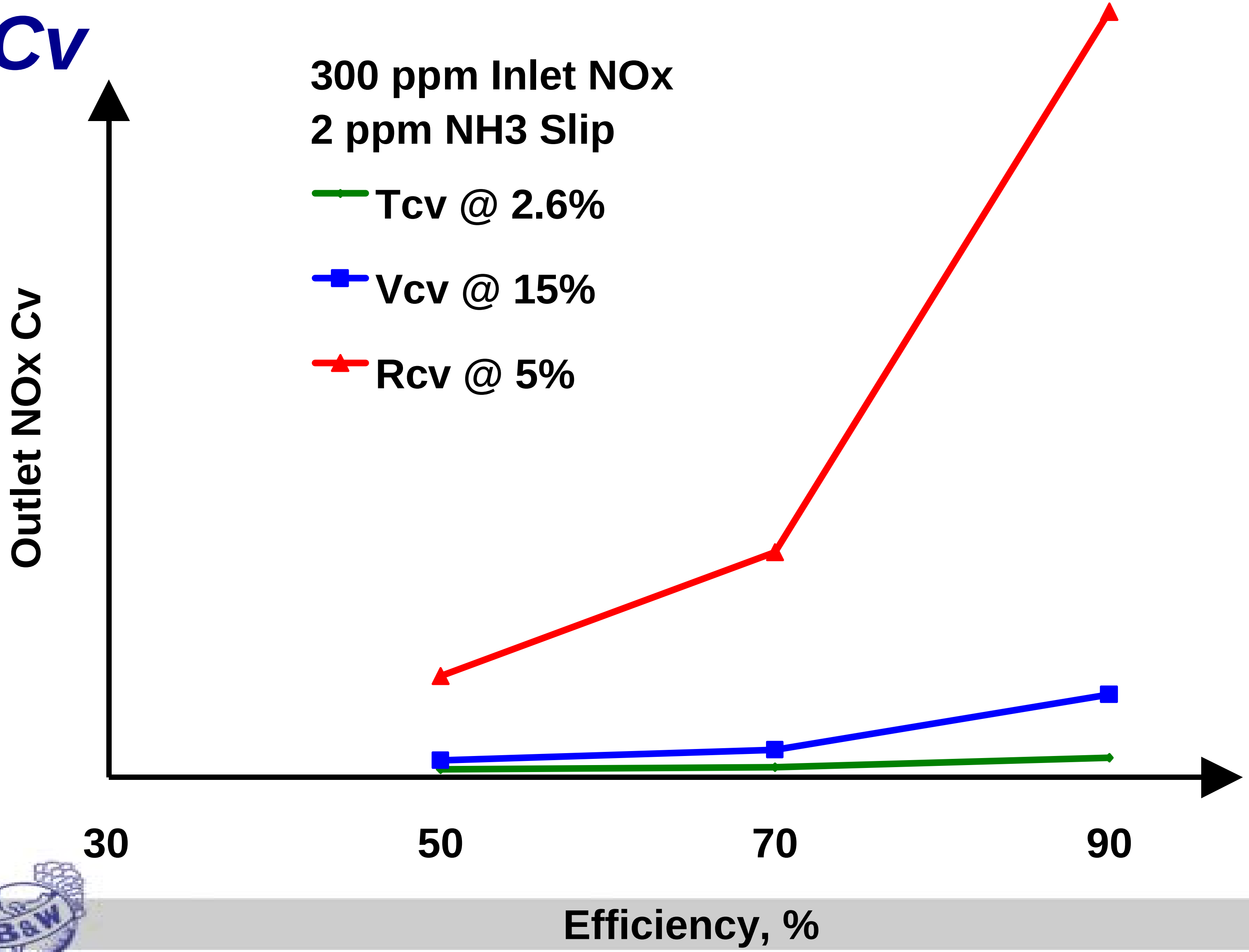
Catalyst Volume vs Molar Ratio Cv



Relative Influence of Typical Gas Fired Inlet Distributions on Reactor Outlet NOx Cv



Relative Influence of Typical Coal Fired Inlet Distributions on Reactor Outlet NOx Cv



Velocity Distribution @ AIG

Performance Criteria

- **Influenced by Targeted Mole Ratio Criteria**
- **Influenced by Design Philosophy**
  - **Upstream Mixing & Flow Conditioning**
  - **Downstream Mixing & Mixing Intensity**
- **Design Range 6% ≤ Cv ≤ 20%**

Control

- **Upstream Flue Geometry**
- **Upstream Distribution/Straightening Vanes**
- **Upstream Blocked Area Structures**
- **Upstream Mixers**

Velocity Distribution @ Catalyst

Performance Criteria

- Performance Effect Typically Less Critical
- Usual Concern - Deposition & Erosion
- Cv $\leq$ 15% Generally Acceptable

Control

- Reactor Inlet Hood Design
- Hood Entrance Vanes
- Hood Interior Vanes
- Blocked Area Structures
- Flow Straightening Vanes or Structures

Temperature Distribution @ Catalyst

Performance Criteria

- Performance Effect Typically Less Critical
- Usual Concern - Sintering & ABS Formation
- Min/Max ± 20F to ± 50F Generally Acceptable

Control

- Economizer Design
- Economizer Bypass Design
- Mixing in Economizer Hopper
- Mixing in Flue Sections

Mole Ratio Distribution @ Catalyst

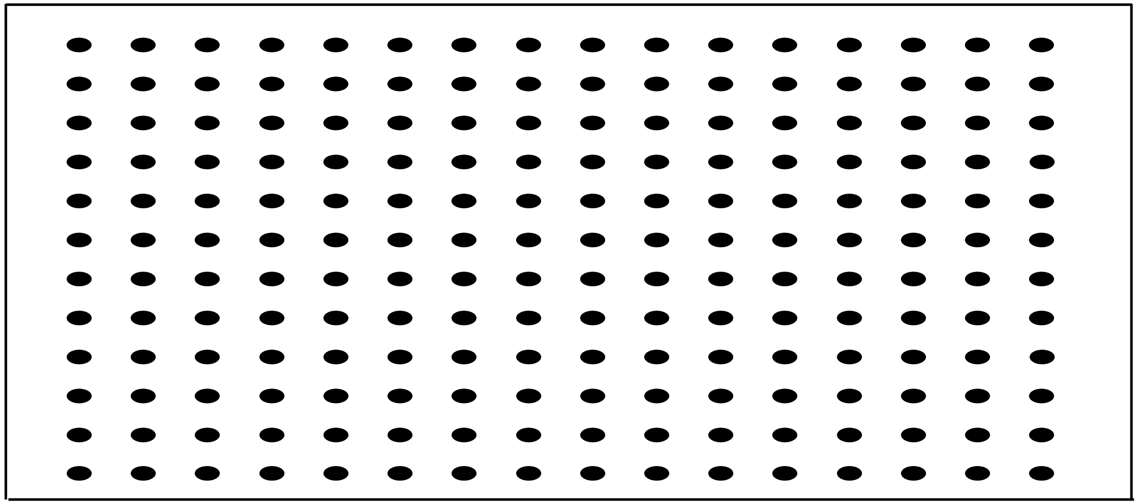
Performance Criteria

- **Sensitive to DeNOx Efficiency**
- **Sensitive to Excess Reagent Levels**
- **Typical Gas Fired Criteria Cv ≤ 10%**
- **Typical Coal Fired Criteria Cv ≤ 5%**
- **Cv ≤ 3% on Coal Firing @ > 90% DeNOx**

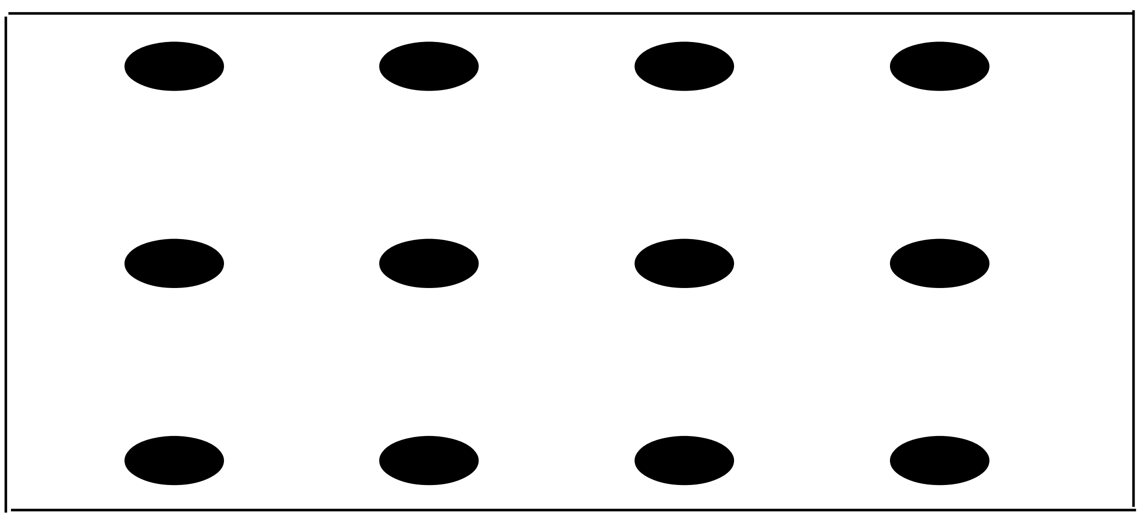
Control

- **NO_x Blending Prior to AIG**
- **Flow Correction Prior to AIG**
- **AIG Design & Ammonia to NOx Dosing**
- **AIG Downstream Blending**

Scale of Segregation & Injection Point Quantity

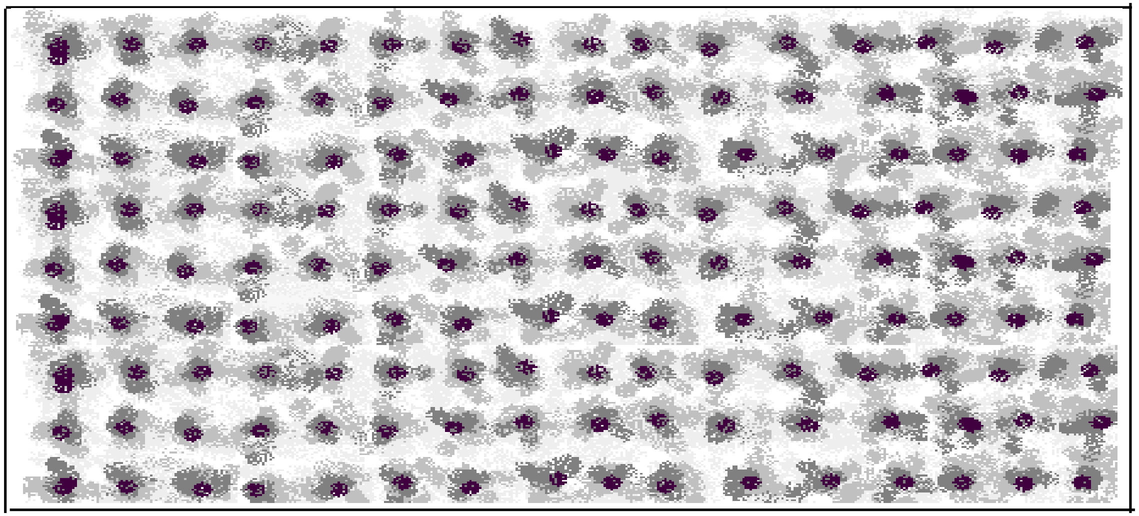


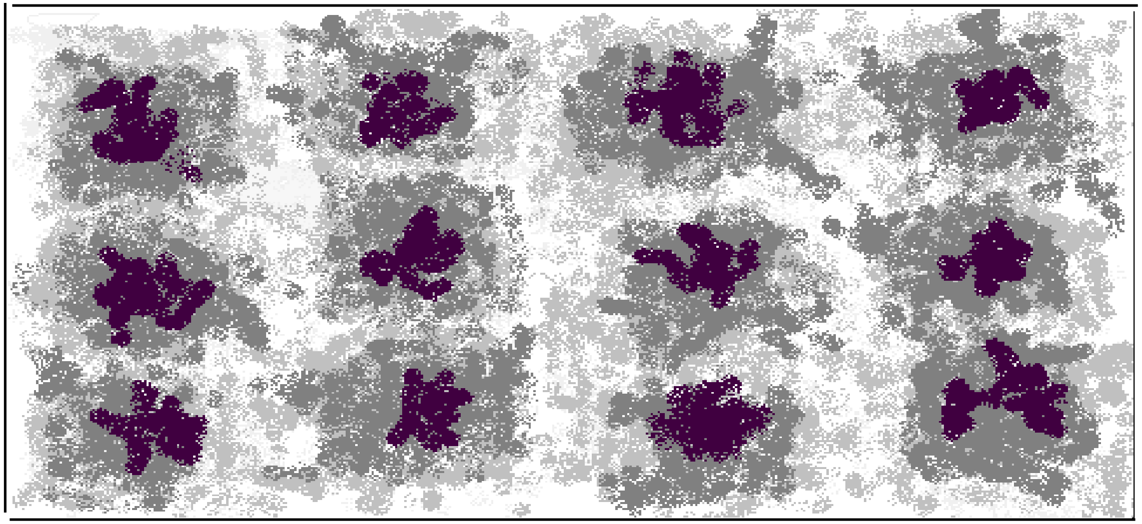
192 pts



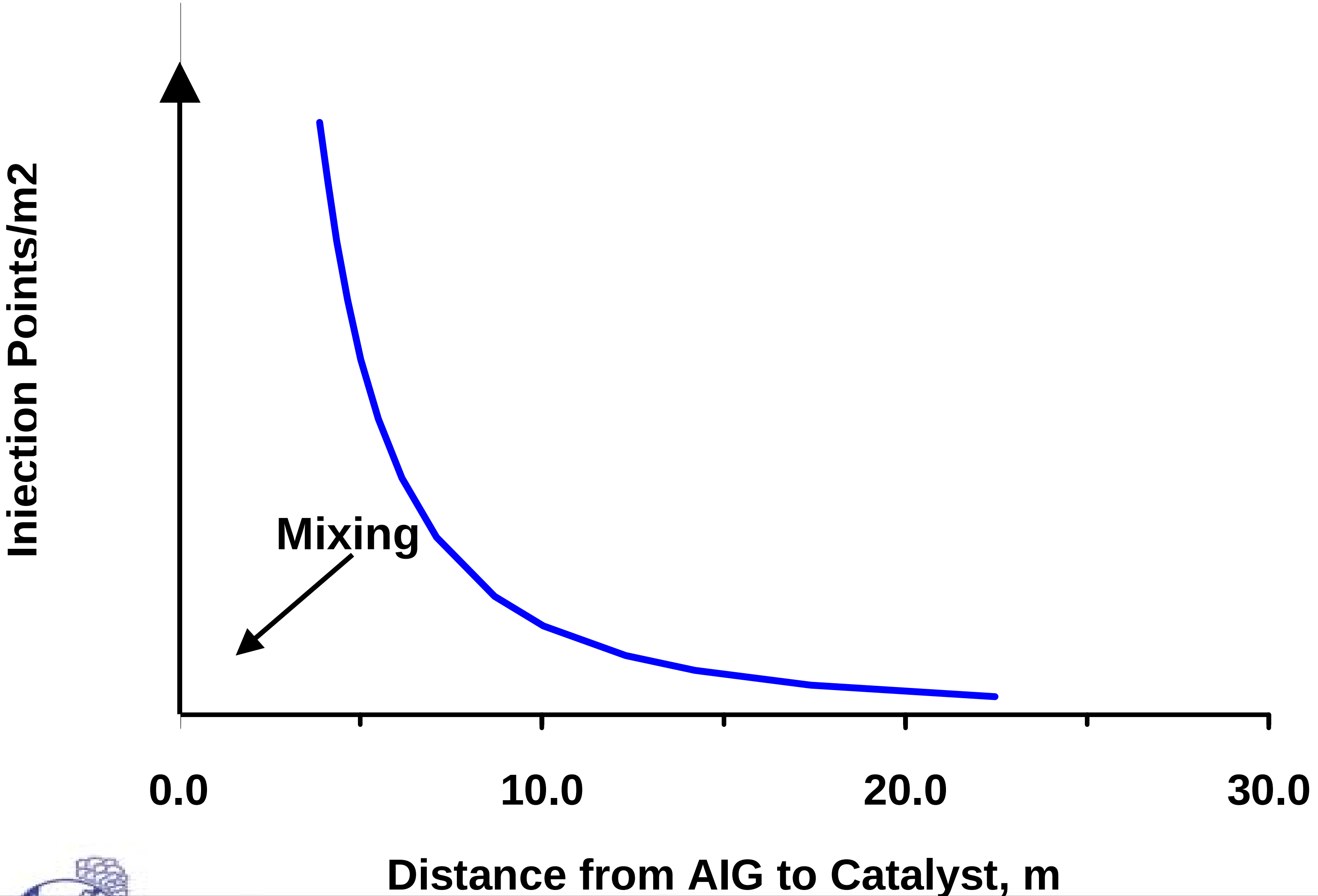
12 pts

Intensity of Segregation

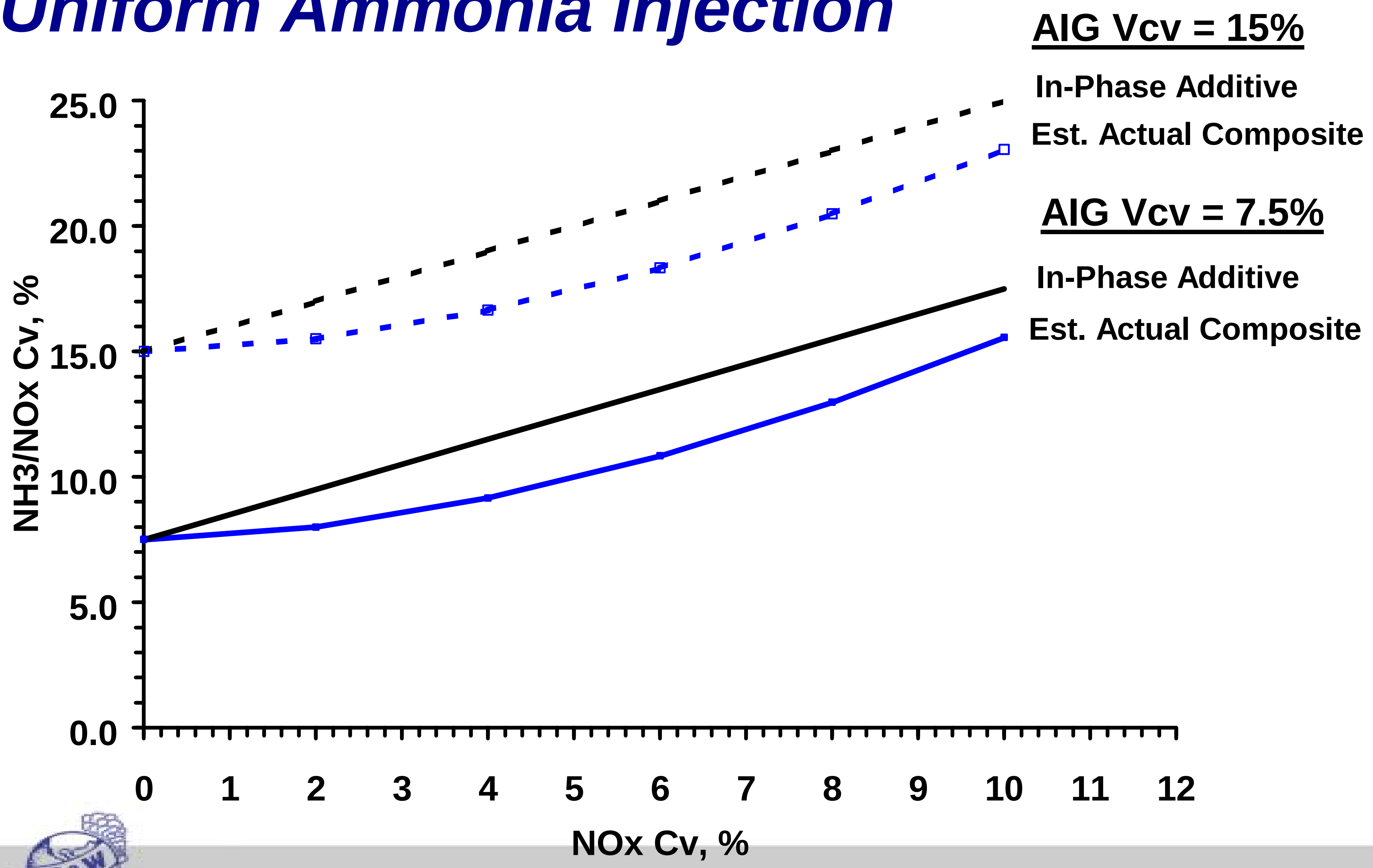




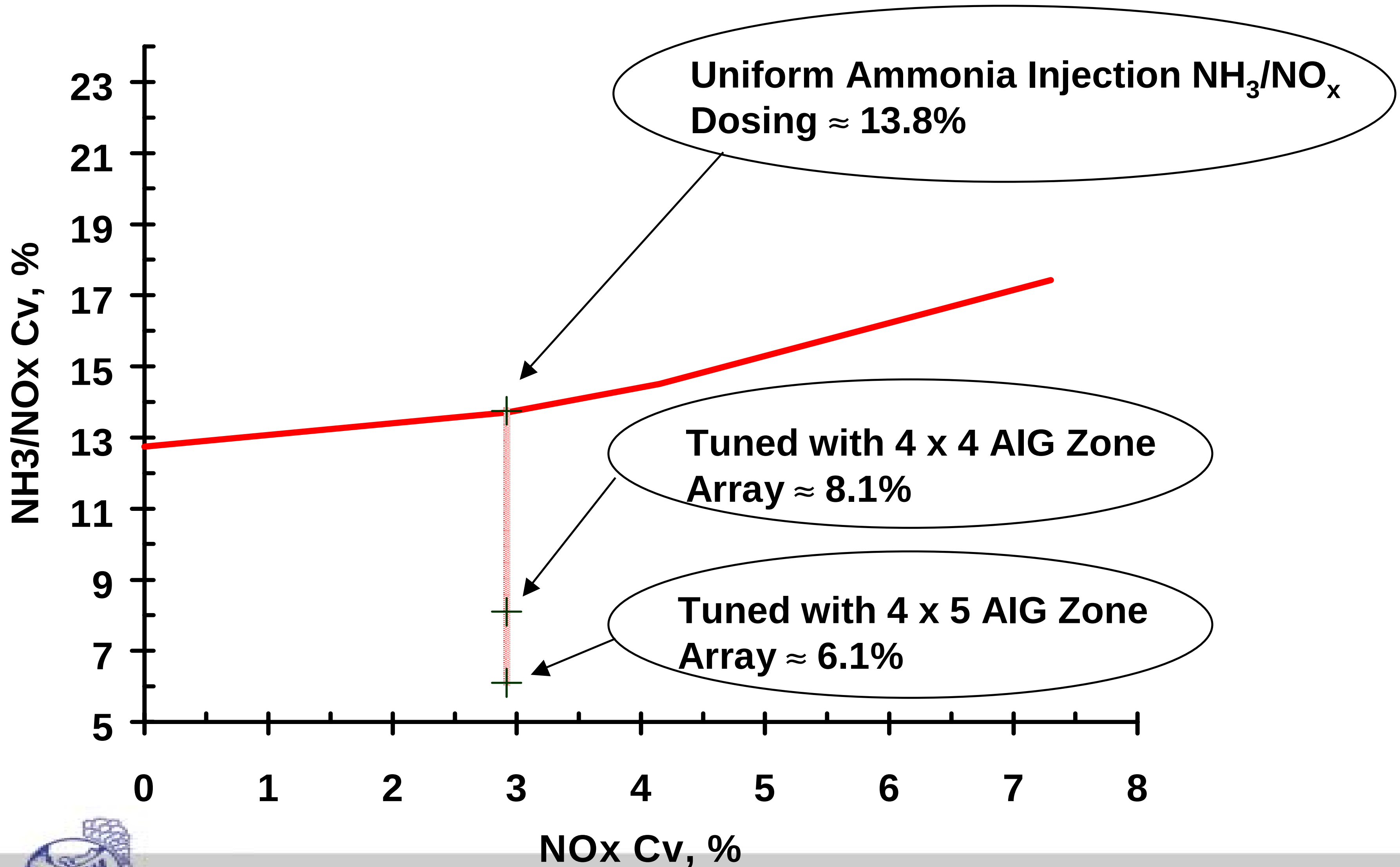
Injection Point Area Concentration vs Separation Distance from AIG-Catalyst



Effective NH_3/NO_x Dosing Profile with Uniform Ammonia Injection

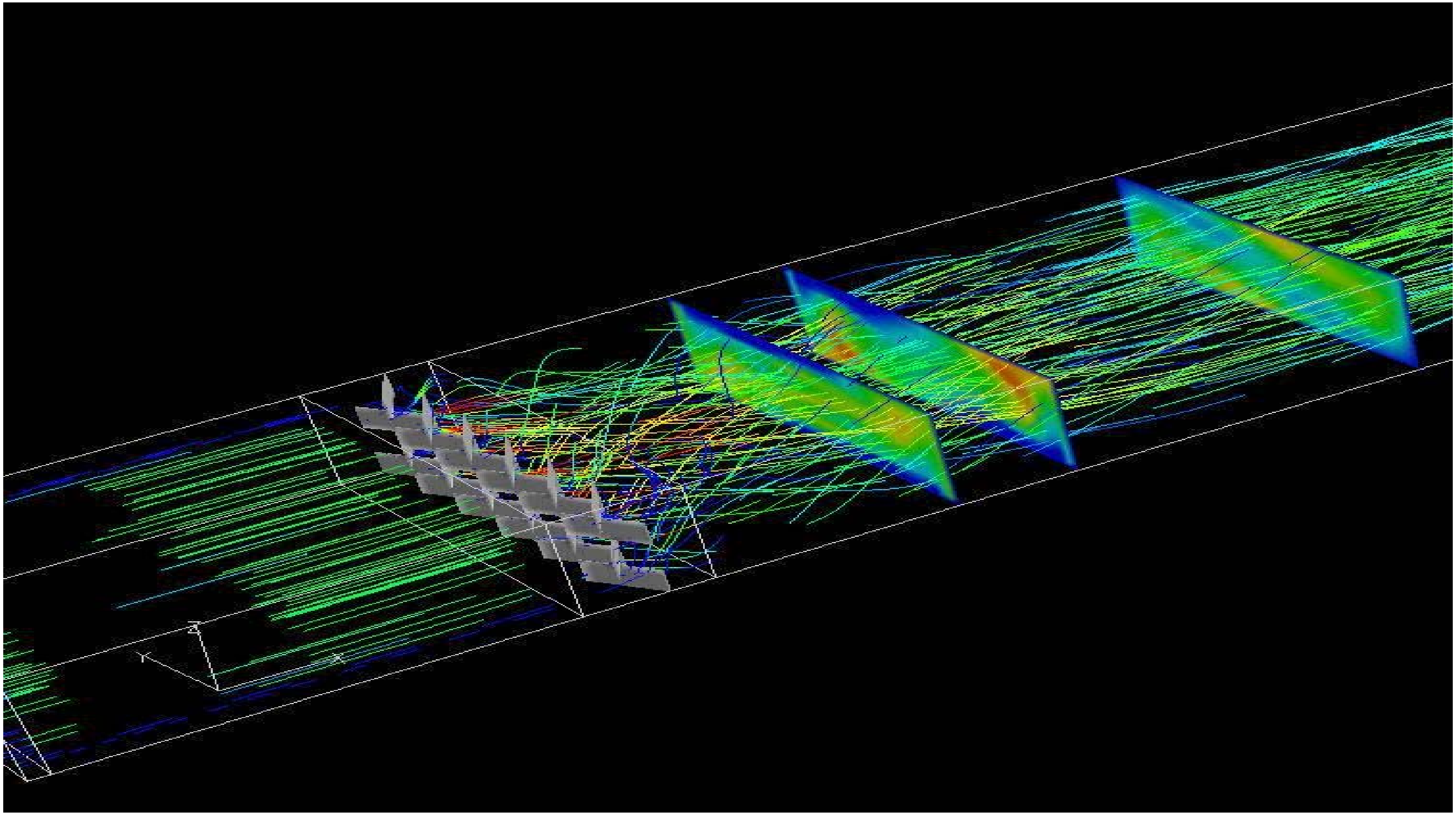


NH_3/NO_x Dosing Profile vs Configuration of AIG

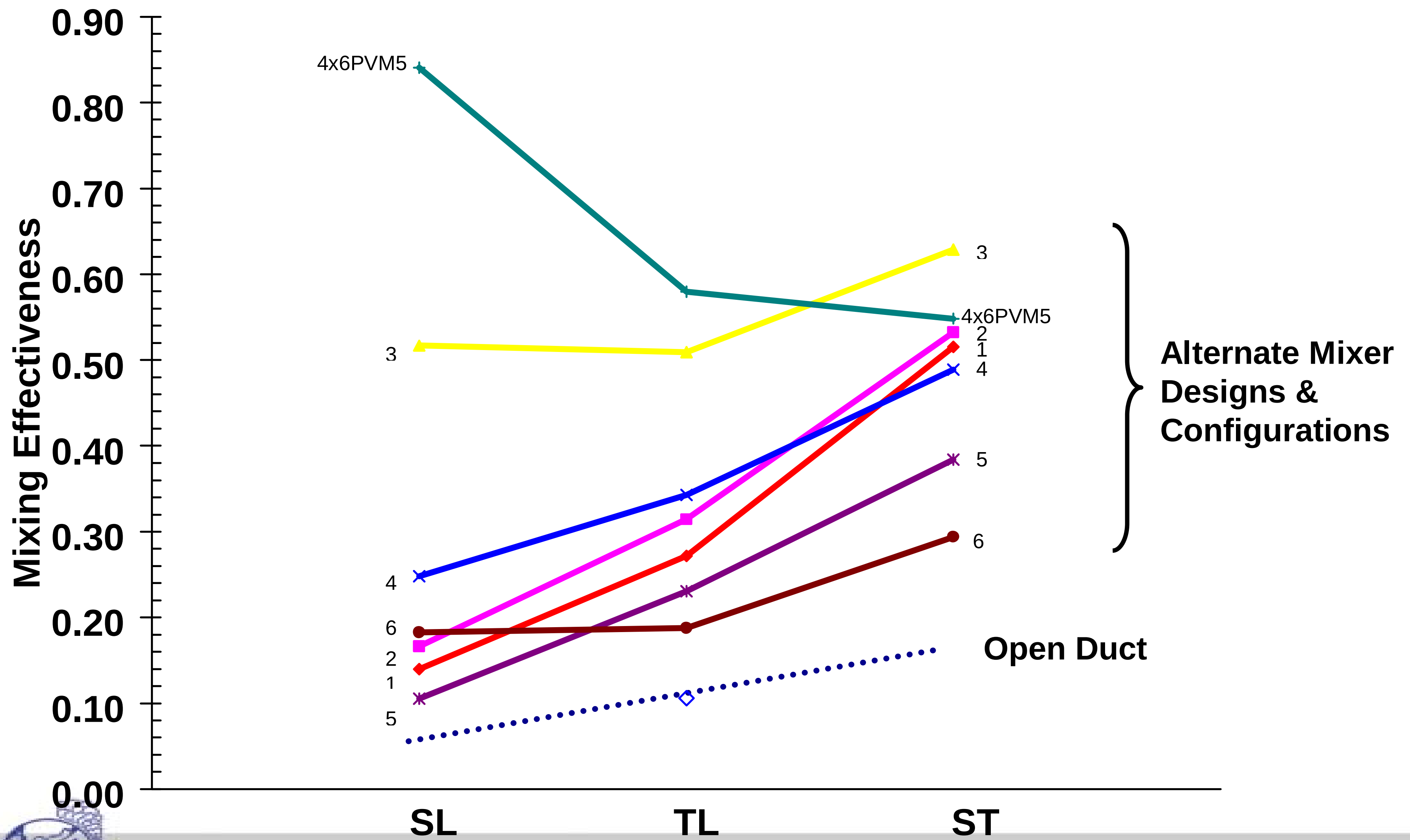


Physical Test Stand
(CFD Validation, Mixer & AIG Performance Testing & Characterization)

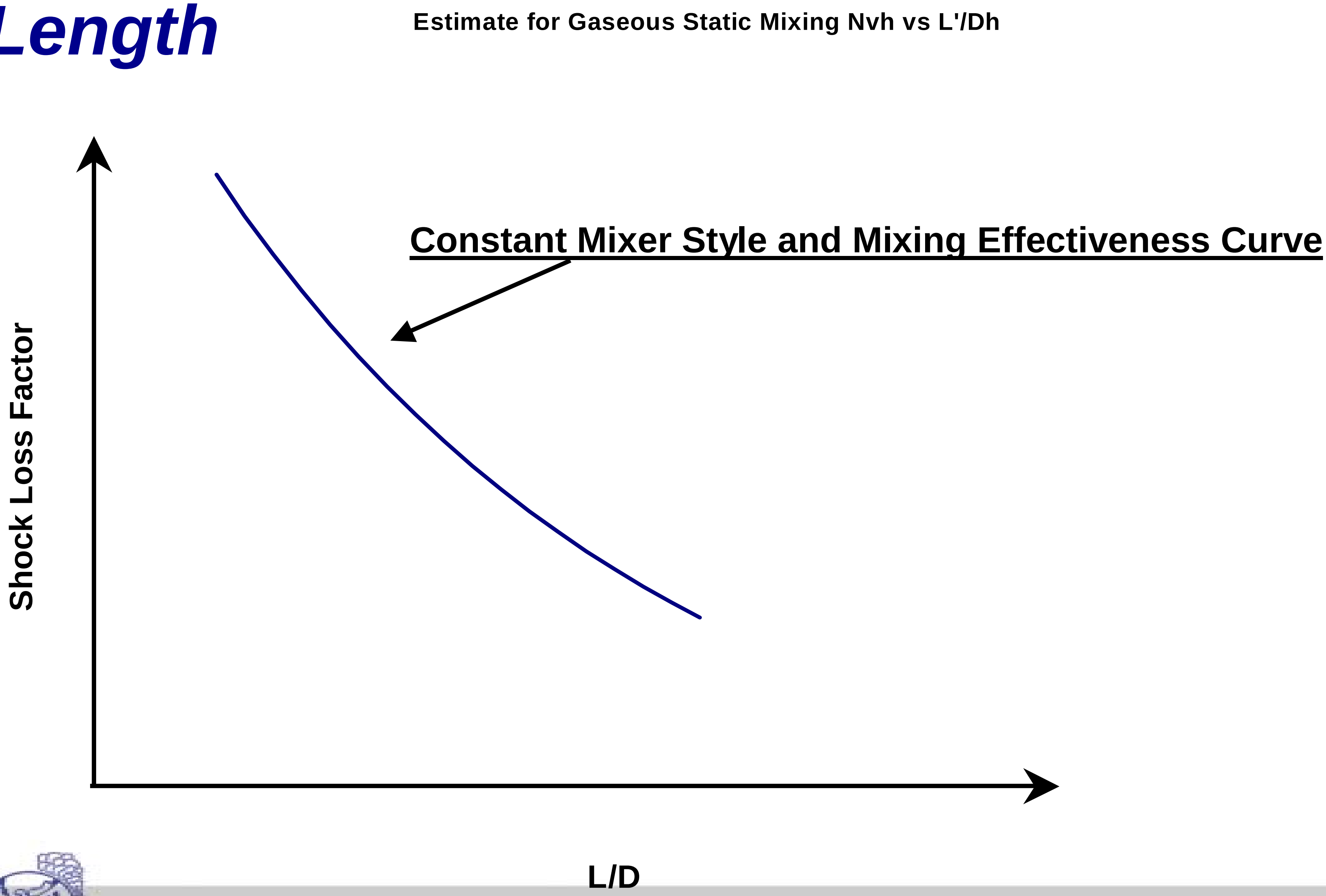
Numerical Test Stand
(Mixer & AIG Performance Testing & Characterization)



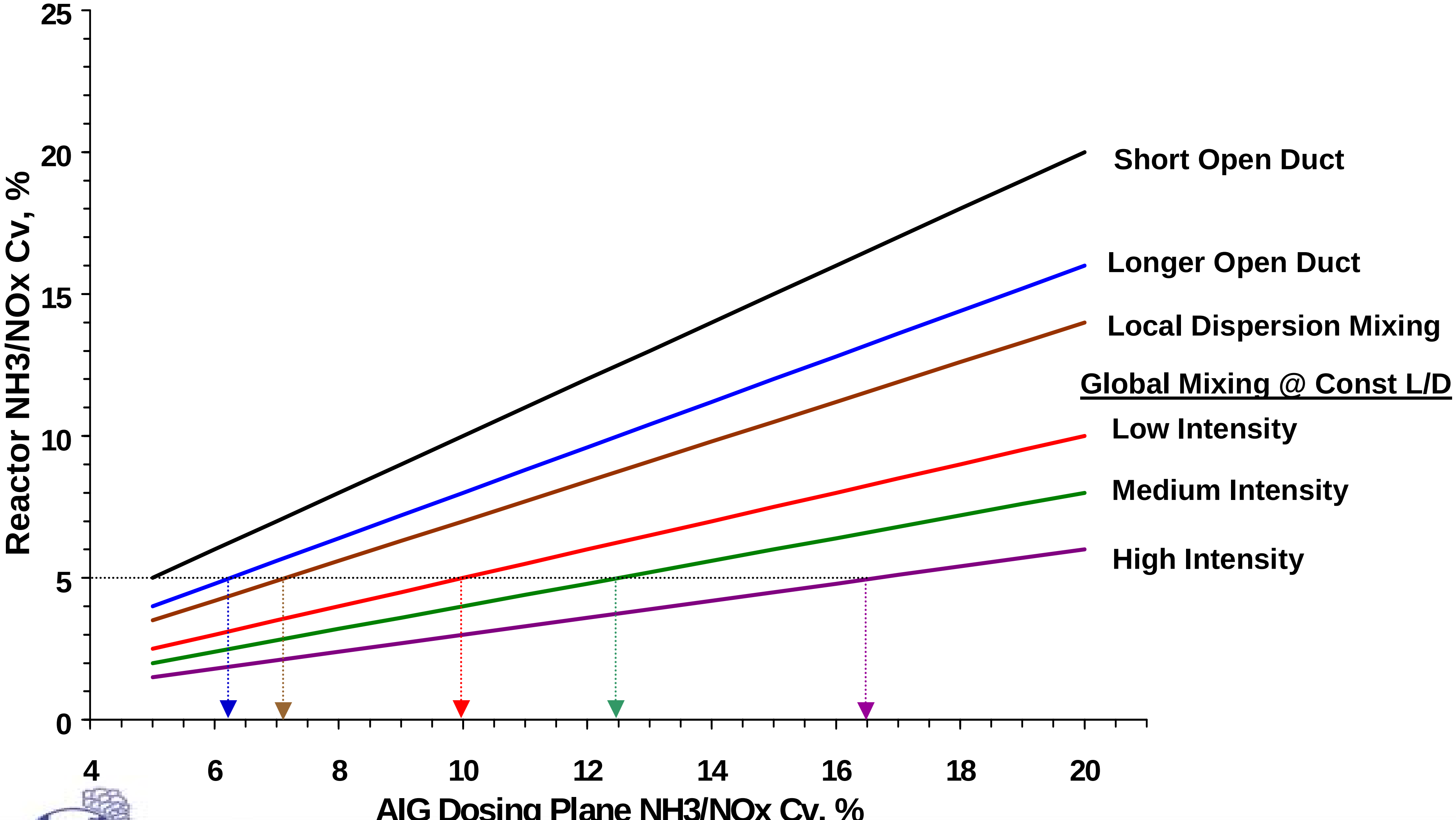
Mixing Effectiveness Determination



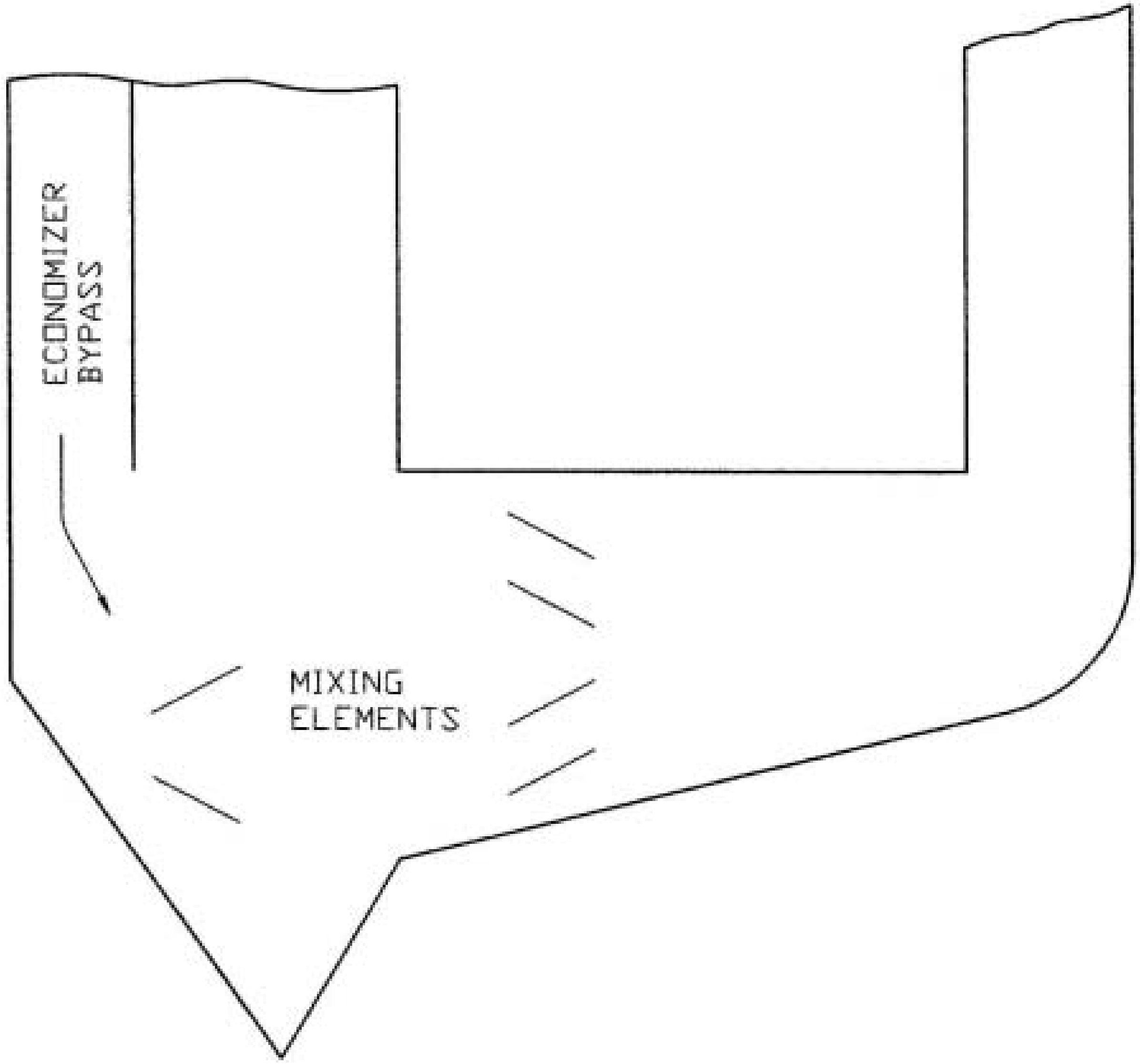
Mixing Pressure Drop vs Available Mix Length



Subsequent Mixing of Dosed NH_3/NO_x Profile



Arrangement vs Design Path



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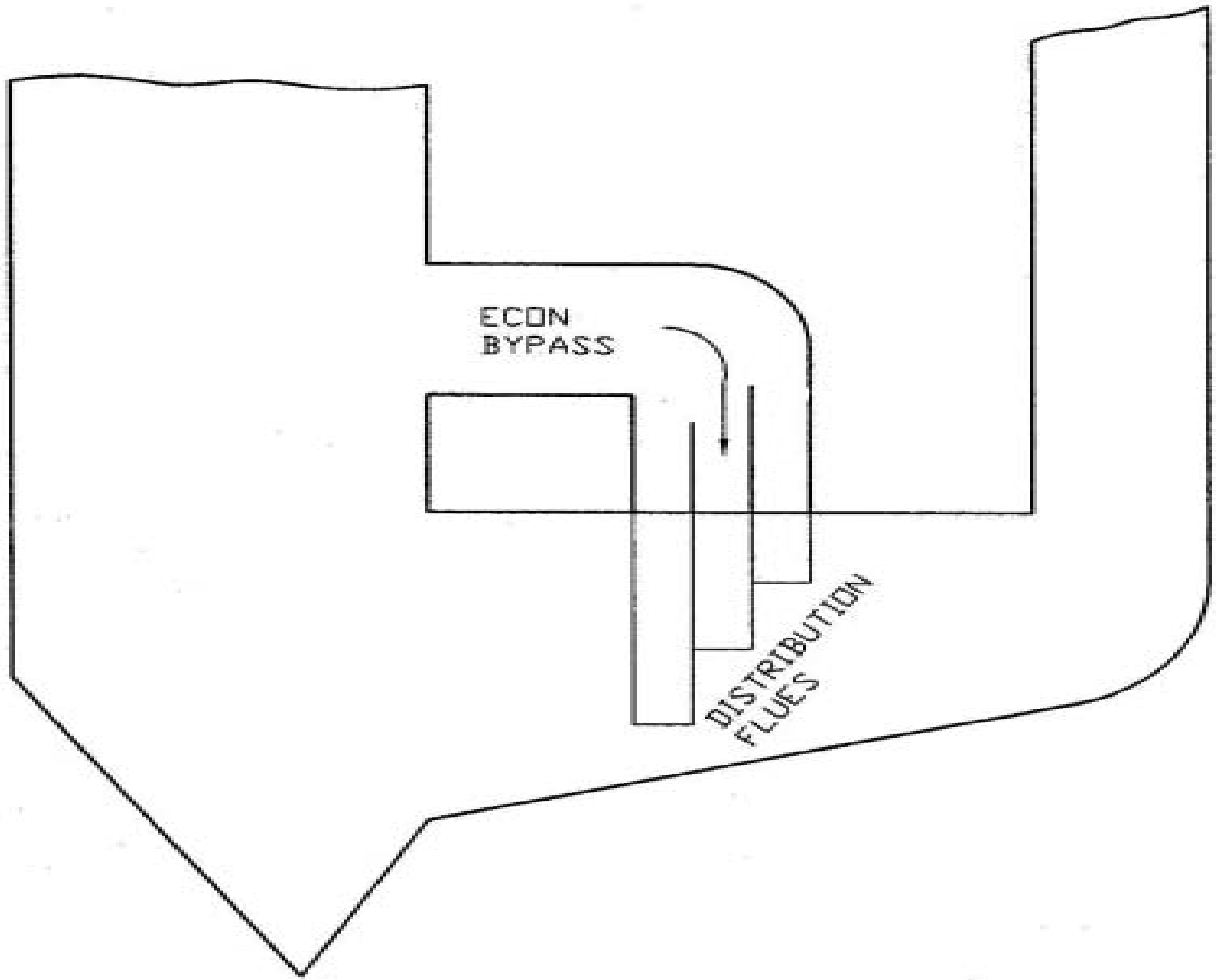

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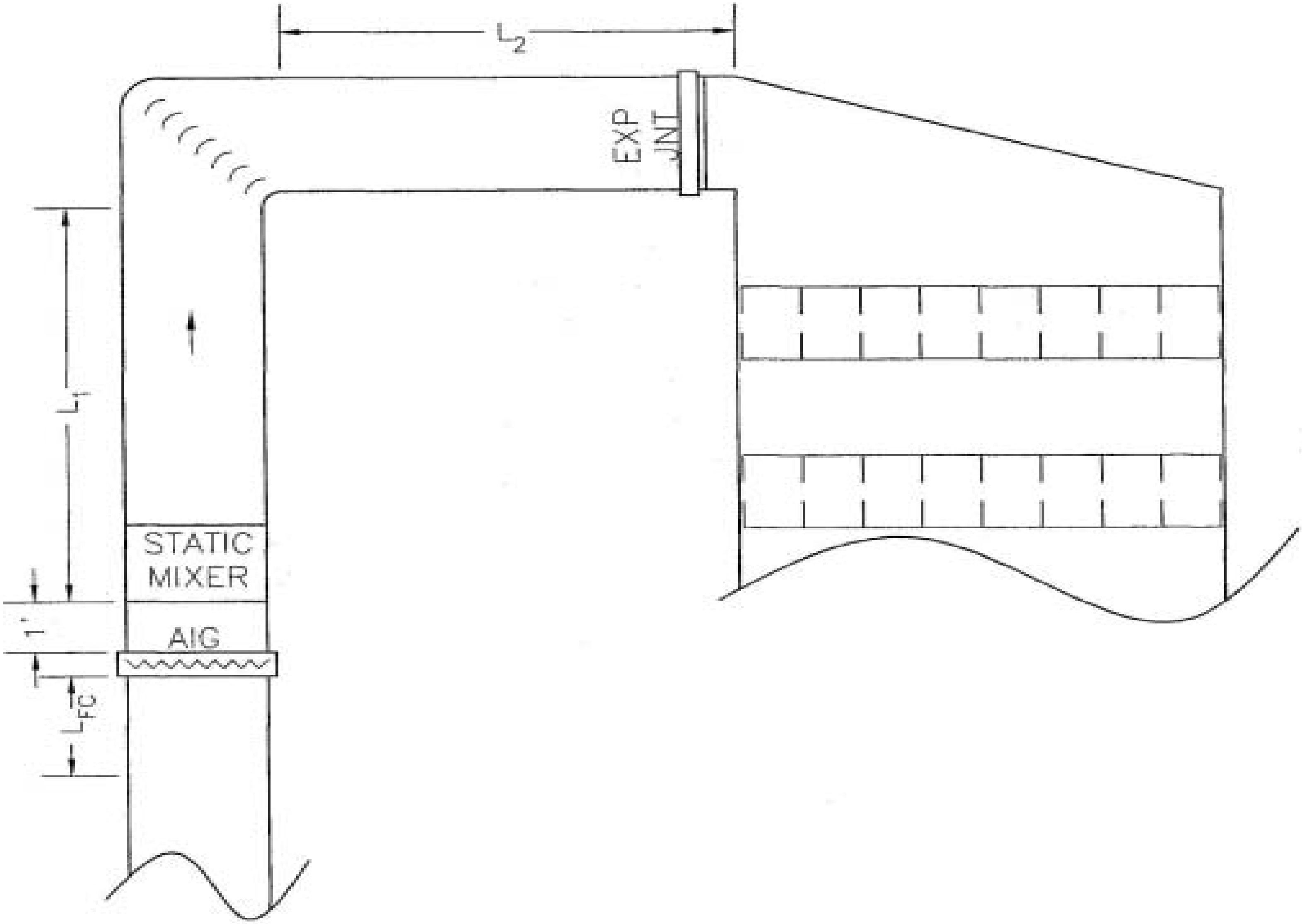

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